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Host insects infested with aquatic mites (Acari: Hydrachnidiae and Stygothrombiae) in Kanagawa and Shizuoka prefectures in Japan

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Abstract — Prostigmatid aquatic mites are known to temporarily live on the surface of aquatic insects in their life cycle. We collected imaginal aquatic insects by hand-sweeping and a light trap on mountain streams in Shizuoka and Kanagawa prefectures in Japan to clarify the parasitic nature of aquatic mites on them. During the survey, 16 genera in 13 families of Trichoptera, four genera in two families of Plecoptera, and three genera in two families of Diptera were recorded as host insects of aquatic mite genera *Protzia, Partnunia, Stygomomonia*, and *Lebertia* in Hydrachnidiae and *Stygothrombium* in Stygothrombiae. Trichoptera was newly recorded as a host taxon of aquatic mites in Japan. The diversity of host insect taxa for *Protzia* was greater than that for the other four mite genera. The host–parasite correspondence between mite and host insect taxa was generally consistent with the results so far obtained.

Key words — Aquatic insects, Hydrachnidiae, Stygothrombiae, parasitism, water mites, Japan

Introduction

In general, larval or post-larval stages of the prostigmatic aquatic mites Hydrachnidiae and Stygothrombiae are parasitic on the body surface of several orders of aquatic insects in their life cycle (Walter & Proctor 1999). Investigations of the host–parasite relationship between aquatic mites and host insects are quite limited in Japan. Most of the studies on aquatic mite parasitism in Japan treat dipteran hosts for biological control against malaria (Yamada 1918). Studies of parasitism on other insect taxa are scarce. Recently, the authors had an opportunity to examine the host–parasite relationship between aquatic mites and aquatic insects in mountainous streams in Shizuoka and Kanagawa prefectures. This paper aims to fill in the gap of knowledge concerning the host–parasite relationship of aquatic mites and host insects in Japan.

Materials and methods

This study was conducted at the Shiba River in Shizuoka Prefecture and the Yataro, Hinata, and Sagami rivers in Kanagawa Prefecture from May 16 to August 1, 2008. Aquatic insects in the adult stage were collected by hand with an insect net in the daytime and by using a light trap at night. On each aquatic insect collected during the study, the parasitism of aquatic mites was examined. When the host insect was infested with aquatic mites, the host and mite taxa were recorded. Larval mites could be identified only as to genus, so the specific preference for a host taxon could not be examined. In addition, the population size of each insect taxon in the study area was unknown. The higher classification of aquatic mites follows Lindquist et al. (2009).

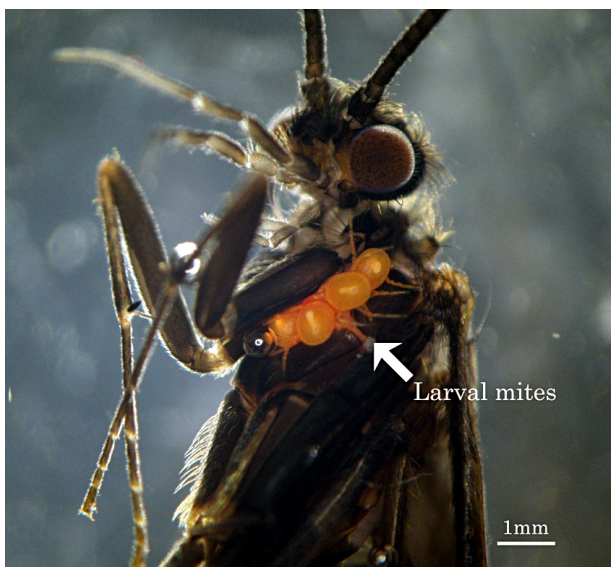

Fig. 1. Larval mites of *Protzia* sp. parasitic on the thorax of *Dolophilodes japonica* (Trichoptera).

Table 1. The number of host individuals infested with aquatic mites collected at the Shiba River in Shizuoka Prefecture and the Yataro, Hinata, and Sagami rivers in Kanagawa Prefecture in 2008.

Host insect taxa	Collecting sites	Collecting dates	Collecting methods	Parasitic mite genera				
				Protzia	*Partnunia*	*Stygomomonia*	*Lebertia*	*Stygothrombium*
TRICHOPTERA								
Rhyacophilidae								
Himalopsyche japonica	Shiba & Yataro rivers	May 16 & 22	Light trap	2				
Rhyacophila brevicephala	Shiba River	May 16 & July 20	Sweeping & light trap	2				
Rhyacophila transquilla	Shiba River	May 16 & 17	Sweeping & light trap	2				
Rhyacophila spp.	Shiba & Yataro rivers	May 16–18, 22, & July 20	Sweeping & light trap	15		15		
Hydrobiosidae								
Apsilochorema sutshanum	Shiba River	May 16 & 17	Sweeping	2				
Hydroptilidae								
Palaeagapetus sp.	Shiba River	May 16	Sweeping	1				
Glossosomatidae								
Glossosoma nichinkata	Shiba River	May 16	Light trap	2				
Glossosoma sp.	Hinata & Yataro rivers	May 22 & Aug. 1	Light trap	2				
Stenopsychidae								
Stenopsyche marmorata	Shiba, Hinata, & Sagami rivers	May 16, 27, July 20, 23, & Aug. 1	Light trap			19		
Philopotamidae								
Dolophilodes japonica	Shiba & Yataro rivers	May 16–18, 22, & June 19	Sweeping & light trap	300				
Wormaldia sp.	Shiba River	May 18	Sweeping	1				
Psychomyiidae								
Tinodes sp.	Hinata River	June 1	Light trap	1				
Polycentropodidae								
Neureclipsis sp.	Shiba River	July 20	Light trap			1		
Nyctiophylax kisoensis	Yataro River	May 22	Light trap	1				
Hydropsychidae								
Hydropsyche orientalis	Shiba River	May 16	Light trap	1				
Hydropsyche sp.	Shiba & Yataro rivers	May 22 & July 23	Light trap	1		2		
Phryganopsychidae								
Phryganopsyche sp.	Shiba River	May 17	Sweeping	1				
Lepidostomatidae								
Lepidostoma speculiferum	Shiba River	May 16	Sweeping & light trap	4				
Lepidostoma sp.	Shiba River	May 16–18, & July 23	Sweeping & light trap	5				
Goeridae								
Goera sp.	Shiba River	July 20	Light trap			1		
Odontoceridae								
Perissoneura paradoxa	Shiba River	May 16	Light trap	1				
Perissoneura sp.	Shiba River	May 16	Sweeping	3				
PLECOPTERA								
Nemouridae								
Amphinemura sp.	Shiba River	May 16	Sweeping		1			
Protonemura sp.	Shiba River	May 16 & 18	Sweeping		2			
Perlodidae								
Pseudomegarcys japonica	Shiba River	July 20	Sweeping					2
Ostrovus sp.	Shiba River	May 16	Sweeping					1
DIPTERA								
Chironomidae								
Orthocladiinae gen. spp.	Shiba & Yataro rivers	May 16 & 22	Sweeping & light trap			2		
Diamesinae gen. sp.	Shiba River	May 16	Sweeping				1	
Limoniidae								
Antocha spp.	Shiba & Yataro rivers	May 16, 18, 22, June 19, & July 20	Sweeping & light trap	126				

Results and discussion

As a result, 16 genera in 13 families of Trichoptera, four genera in two families of Plecoptera, and three genera in two families of Diptera were recorded as host insects of aquatic mites (Table 1). Trichoptera was newly recorded as a host taxon of aquatic mites in Japan. The infested host insect taxa collected by sweeping in the daytime were different from those acquired by a light trap at night. Infested hosts in only five genera were commonly obtained by these two different collecting methods. On the other hand, mite-infested Plecoptera was exclusively collected by hand-sweeping.

All mites collected from aquatic insects were in their larval stage. The parasitic larval mites were identified as *Protzia* and *Partnunia* in Hydryphantidae, *Stygomomonia* in Momoniidae, *Lebertia* in Lebertiidae in the subcohort Hydrachnidiae, and *Stygothrombium* in Stygothrombiidae in the subcohort Stygothrombiae. Smith and Oliver (1986) reviewed parasitic associations of larval water mites with insect hosts and indicated the existence of a host–parasite association of *Protzia* with Trichoptera and Diptera, *Partnunia* with Plecoptera, *Lebertia* with Diptera, and *Stygomomonia* with Trichoptera. Plecoptera was recorded as the host of Hydryphantidae for the second time in Japan since Imamura (1950) noted the following host taxa for *Partnunia uchidai* in Hydryphantidae: *Alloperla jezoensis, Nemoura* spp., *Protonemura* sp., and *Arcynopteryx jezoensis*. Plecoptera is also known to be a host taxon for *Stygothrombium* in North America (Mullen 1979, Yasick et al. 2003). The host–parasite associations between aquatic mites and insect taxa observed in the present study were generally consistent with the results of research in Western countries.

Each mite genus was parasitic to a unique host taxon except for two cases in which *Rhyacophila* spp. and *Hydropsyche* sp. were infested with both *Protzia* and *Stygomomonia*. The number of infested hosts with *Protzia* was significantly larger than that with *Lebertia, Stygothrombium*, and *Partnunia* (pairwise t test, $p < 0.05$). The diversity of host insect taxa for *Protzia* was greater than that for the other four mite genera. Further, *Protzia* was mostly found on *Dolophilodes japonica*. (Table 1, Fig. 1) in Trichoptera, followed by *Antocha* spp. in Diptera. *Stygomomonia* was parasitic on Trichoptera and Diptera and found mainly on *Stenopscyche marmorata* and *Rhyacophila* spp. in Trichoptera. On the other hand, *Partnunia* was collected only from *Amphinemura* sp. and *Protonemura* sp. in Plecoptera; *Lebertia* from Diamesinae gen. sp. in Diptera; and *Stygothrombium* from *Pseudomegarcys japonica* and *Ostrovus* sp. in Plecoptera. A behavioral pattern of aquatic mites seems to have an influence on host selection. *Stygothrombium*, and probably *Partnunia* as well, inhabits coarse, sandy deposits in a stream that is a preferable habitat for plecopteran insects. Consequently, Plecoptera is considered to be solely infested with *Partnunia* and *Stygothrombium*.

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